NON-PUBLIC?: N
ACCESSION #: 9004180204
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Palisades Nuclear Plant PAGE: 1 OF 06

DOCKET NUMBER: 05000255

TITLE: PRIMARY COOLANT SYSTEM COOLDOWN DURING MAIN FEEDWATER PUMP TRIP
RECOVERY RESULTS IN VARIABLE HIGH-POWER INITIATED REACTOR TRIP
EVENT DATE: 02/28/90 LER #: 90-002-00 REPORT DATE: 03/30/90

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 80

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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Palisades

COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: IB COMPONENT: ANN MANUFACTURER: G128
REPORTABLE NPRDS: No

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT:

At 1826 hours on February 28, 1990, Palisades experienced an unanticipated trip of the "B" main feedwater pump (MFP). During recovery from the pump trip, a reactor trip was initiated by an automatic actuation of the Reactor Protection System (RPS). Prior to the feedwater pump trip the reactor had been operating at 80 percent power, with both feedwater pumps operating and the Primary Coolant System (PCS) at 556 degrees F and 2060 psia. When the reactor trip occurred, the Plant was operating at 55 percent reactor power.

The initating event for the reactor trip was cooldown of the PCS during recovery from loss of a main feedwater pump. The reactor trip was not caused by personnel error. However, operator actions which could have been taken to control the effects of the cooldown transient and prevent

the reactor trip were impaired by a momentary loss of audible annunciator system and a malfunction of the automatic start feature for charging pump "C". The cause of the MFP trip remains indeterminate. Investigation of the feedwater pump trip remains in progess. Temporary monitors have been installed on the MFPs in order to provide additional information should there be any further MFP abnormalities or trips. Licensed operators will receive training on the circumstances surrounding the reactor trip and procedures will be enhanced to warn operators of the potential for a PCS cooldown during recovery from loss of a feedwater pump. This event was contributed to a failed annunciator chime bell (Edwards, Catalog Number 339-P1).

END OF ABSTRACT

Description

At 1826 hours on February 28, 1990 the Plant was approximately six minutes into recovery from an unanticipated trip of the "B" main feedwater pump (MFP) SJ;P! when the Reactor Protection System (RPS) JC! was automatically actuated. The RPS actuation was initiated by the variable high-power trip feature, and resulted in a reactor trip. Prior to the feedwater pump trip, the reactor had been operating at approximately 80 percent power, with both MFPs operating and the Primary Coolant System (PCS) AB! at 556 degrees F and 2060 psia. When the reactor trip occurred the reactor was operating at approximately 55 percent power.

Following the "B" MFP trip, which occurred at 1820 hours, operator actions were immediately taken to reduce power as directed by procedure. Power reduction was necessary following the feedwater pump trip because a single feedwater pump cannot match steam demand when operating above approximately 60 percent power. Reactor power was reduced to approximately 45 percent power during recovery from the feedwater pump trip.

A mismatch in steam flow and feedwater pump capacity existed during the .recovery period due to steam demand exceeding the capacity of the single operating feedwater pump. This mismatch resulted in decreased steam generator AB;BLR! inventories and lowered the water level in the steam generators below the automatic level controller JB;LIK! setpoint. As a result, when power was eventually reduced to the point that steam demand was below feedwater pump capacity, the steam generators began to rapidly refill in order to recover programmed level. The rapid influx of relatively cold feedwater into the steam generators during refill

resulted in a depression of PCS cold leg temperature. This temperature depression subsequently resulted in an increase in reactor power due to negative moderator coefficient effects.

When reactor power was manually reduced to approximately 45 percent during the MFP trip transient recovery, the variable high-power trip setpoint was automatically reduced and reset at approximately 55 percent reactor power. The increase in reactor power that resulted from rapid filling of the steam generators was indicated on both the calculated delta-T and the neutron monitoring IG! instrumentation channels, and was sufficient to actuate the variable high-power trip feature on calculated delta-T reactor power. As a result, an automatic reactor trip was initiated at 1826 hours.

Steam generator levels were maintained in automatic control following the (B) MFP until after the reactor trip by the "A" MFP. Following the reactor trip, the "A" MFP turbine was manually tripped at 1827 hours and the motor driven auxiliary feedwater pump BA;P! was manually started. Steam generator levels remained above the auxiliary feedwater actuation system automatic start setpoint throughout recovery from the MFP trip and reactor trip.

The variable high-power trip feature that initiated the reactor trip is designed to actuate when the high auctioneered value from either calculated delta-T reactor power or neutron monitoring reactor power exceeds the trip setpoint. The variable high-power trip is maintained at 10 percent above the operating reactor power level during steady state conditions, and is dynamic during power reductions. The trip setpoint automatically decreases to maintain a maximum setpoint of 10 percent above the highest auctioneered value of reactor power when power is decreased. The trip setpoint does not automatically reset to compensate for increases in reactor power. During normal operations, the variable high-power trip setpoint is manually reset, as needed, to facilitate planned increases in reactor power.

The power increase that caused the reactor trip occurred over a relatively brief period of time (1-2 minutes). Operator actions could have been taken to limit the power increase and prevent the reactor trip. However these actions were delayed by events that obscured the cooldown initiated power increase from Control Room personnel. Several minutes before the reactor trip there was a loss of the audible functions associated with the Control Room annunciator system. Additionally, the

reactor board operator was responding to an automatic start problem on charging pump "C" just prior to the reactor trip. Operator actions taken during the event were in accordance with procedures.

Investigation Results

An investigation into the cause of the MFP trip was initiated following recovery from the reactor trip. The investigation identified that Instrument and Control (I&C) Technicians were performing gauge calibrations inside the local control panel that contains the vibration alarm and thrust bearing trip modules for the "B" MFP just prior to the MFP trip. It was also noted that a paper towel was found covering the vibration alarm module and the thrust bearing trip module vents. Discussions with the vendor indicate that the vibration module and bearing thrust trip module are temperature sensitive. Although it is possible that covering the module vents could have caused the feedwater pump to trip due to reduced air flow, this cannot be proven and is not considered probable. It has also been determined that the work being performed by I&C Technicians prior to, and at the time of, the MFP trip did not cause the pump trip. Statements taken after the trip indicate that the technicians were not performing work in the MFP vibration monitoring cabinet at the time of the pump trip, but were working on an unrelated portion of the MFP gland steam system. The gauges located in the vibration monitoring cabinet which were being calibrated prior to the trip could not have caused the feedwater pump trip.

Prior to the MFP trip, the Shift Supervisor noted that Control Room indication of MFP vibration was downscale. While discussing the downscale

vibration indication with the I&C Technicians in the field, the Shift Supervisor also noted that pump vibration indications on the meter located at the local vibration panel indicated downscale. After the module vents were cleared and the cabinet was checked for loose wires, vibration indications returned to normal. It was several minutes later when the "B" MFP tripped. The cause of the downscale vibration indications that were received before the feedwater pump trip have not been identified, but may be related to the covered module vents or to a loose wire.

Other investigation related actions included checking the lube oil and control oil systems for proper temperature, pressure and general

operations. During this checkout, it was discovered that the "B" pump control oil pressure was approximately 25 psig lower than expected. Low control oil pressure is not believed to have caused the pump trip since control oil pressure was still 30 psig above the trip setpoint. It has been determined that continued operation at the present control oil pressure is acceptable on an interim basis.

Proper operation of "B" MFP trip circuit components was also verified. These tests included: observing that the pressure switches for the suction pressure trip operated at the correct setpoint, checking the time delay for the suction pressure trip and checking operation of the latch and reset relays. Additionally, the "B" pump thrust trip relay module was replaced due to corrosion found on the printed circuit and a coaxial cable for the "B" pump thrust probe was respliced. The corroded circuit board was cleaned and tested and it was determined not to have caused the pump trip.

The vendor that supplied the feedwater pump vibration alarm and thrust trip instrumentation package was contacted to assist in the pump trip investigation. During the vendor visit the vibration and thrust trip instrumentation was examined and the following actions were taken for both MFPs: a diode replacement was performed on the vibration module circuit board, electrical connectors on the vibration alarm module and the thrust trip module were cleaned, and the vibration alarm module and thrust trip module were recalibrated.

Equipment malfunctions noted during the event indcluded a momentary loss of function for the Control Room annunciator IB;ANN! chime bell, and automatic start problems associated with charging pump "C". The annunciator chime bell stopped operating approximately three minutes into the MFP trip recovery, and began operating normally again approximately 17 minutes later, at 1840 hours. Similar losses of chime bell operation were also noted on other occasions after the MFP trip. An investigation conducted to determine a cause for the momentary loss of audible annunciator system functions was performed. This investigation identified a faulty solenoid coil in the chime (Edwards, Catalog Number 339-P1). The chime was replaced and annunciator chime bell operation has returned to normal.

Cause Of The Event

The cause of the reactor trip was loss of a MFP. The reactor trip was

not caused by personnel error, however, it was contributed to be misoperations of the annunciator chime bell and the "C" charging pump. Operator actions which could have been taken to control the effects of the cooldown induced power transient and prevent the reactor trip were impaired by both of these items. The cause of the MFP trip remains indeterminate despite extensive investigation.

This event did not involve any actions that were not in accordance with a procedure, inadequacies in a procedure, or activities that were not covered by a procedure. The performance of required safety systems and components was as expected during the event.

An investigation conducted to determine a cause for the momentary loss of audible annunciator system functions was performed. This investigation identified a faulty solenoid coil in the chime (Edwards, Catalog Number 339-P1). The chime was replaced and annunciator chime bell operation has returned to normal.

The automatic start problems exhibited by charging pump "C" during this event were caused by a wiring error. This error occurred during a recent modification and was not detected previously because it was outside the scope of test procedures. The wiring error caused initiation and seal-in of a trip signal to the "C" charging pump following receipt of an automatic start signal. The wiring error did not affect the ability of operators to manually start the "C" charging pump from the Control Room.

Corrective Actions Taken

As corrective actions, extensive investigation of the "B" MFP trip was performed and monitoring of "B" MFP lube oil pressure and governor JK! oil pressure has been established. This monitoring is being undertaken on a temporary basis as an extension of a similar corrective action previously taken for the "A" MFP. Additionally, monitoring of the trip solenoid has been provided for both MFPs. Trip solenoid monitoring will provide indication of electrical or mechanical pump trip initiation should there be any further MFP trips. The temporary monitors will provide diagnostic information that will be of assistance in the event of further feedwater pump operational abnormalities or trip in the future.

Additional actions have been taken to increase main feedwater pump vibration IV! and thrust monitoring reliability, the connectors on the thrust trip and vibration alarm modules RLY! have been cleaned for both the "A" and "B" MFPs. Other reliability oriented actions have also been taken. A vendor

supplied upgrade to the bearing thrust trip circuitry has been incorporated, an MFP turbine driver will be disassembled and inspected and the thrust probe on the "B" MFP that was found to have a spliced signal cable will be replaced. The thrust trip circuitry modification will improve reliability of the thrust trip seal-in indication. Turbine driver disassembly and inspection and, thrust probe replacement are expected to be complete prior to December 31, 1990.

Training is being prepared for licensed operators on the transient aspects of this event. Additionally, a caution will be inserted in the procedure used to direct operator actions following loss of a main feedwater pump. The caution will alert operators that a PCS cooldown can occur during the steam generator refill phase of recovery from loss of a feedwater pump. Training and procedural enhancements are expected to be completed by December 31, 1990.

The Control Room annunciator chime bell has been replaced and the wiring error for charging pump "C" has been corrected.

Analysis Of The Event

Plant and operator actions taken in response to the reactor trip and MFP trip were in accordance with procedures, with no safety significant deviations or abnormalities. Also, although the reactor trip did not result in a challenge to any safety systems, if any safety equipment had been required during the recovery, both trains of safety equipment were operable and available for use at all times. As a result, this event did not have an adverse impact on the operational safety of the Plant or upon the safety of Plant personnel or the general public.

Additional Information

A similar, previous event involving an unexplained MFP trip was reported in Licensee Event Report 90-001. Investigation of this previous event remains in progress and has incorporated the information collected during the most recent MFP trip.

LER 90002-LI01

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Washington, DC 20555

DOCKET 50-255 - LICENSE DPR-20 - PALISADES PLANT -
LICENSEE EVENT REPORT 90-002 - PRIMARY COOLANT SYSTEM COOLDOWN DURING
MAIN FEEDWATER PUMP TRIP RECOVERY RESULTS IN VARIABLE HIGH-POWER
INITIATED REACTOR TRIP

Licensee Event Report (LER) 90-002 (Primary Coolant System Cooldown During Main Feedwater Pump Trip Recovery Results in Variable High-Power Initiated Reactor Trip) is attached. This event is reportable to the NRC per 10CFR50.73(a)(2)(iv).

Brian D Johnson
Staff Licensing Engineer

CC Administrator, Region III, USNRC
NRC Resident Inspector - Palisades

Attachment

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